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Planning for Sustainable Tourism Development based on Local Wisdom in Samosir Island, Indonesia: Challenges and Opportunities

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Abstract

Tourism as a sector has contributed significantly to regional development, and its activities often bring aggregate benefits to local and national economic growth. Moreover, tourism activities require meticulous planning, particularly in the domain of regional tourism development. As a destination rich in Batak Toba culture and the natural beauty of Lake Toba, Samosir is faced with a dilemma between maximizing its tourism potential and preserving its cultural heritage. This study seeks to develop a planning strategy for sustainable tourism on Samosir Island, drawing upon local wisdom and practices. The research employs a mixed-methods approach, incorporating Participatory Rural Appraisal (PRA) alongside quantitative analysis through Smart PLS, with a sample size of 100 respondents. The study's findings indicate that local values can be effectively integrated into regional development planning for tourism areas, thereby fostering sustainable tourism and promoting adaptive, inclusive policies. However, the integration of local wisdom into tourism policies remains challenged by structural issues, including low institutional capacity and the lack of a fully developed framework, which requires a strategic approach to regional development planning in tourism areas that leverage their local values. According to the quantitative results, regional development planning has a significant positive effect on sustainable tourism ($\beta = 0.407$; $p = 0.000$), local wisdom shows a strong role in supporting sustainable tourism ($\beta = 0.571$; $p < 0.001$), and tourist areas have a large effect on local wisdom ($\beta = 0.658$; $p < 0.001$) but the direct effect of tourist areas on sustainability is not significant ($\beta = –0.047$).

Keywords

Planning; Regional development; Sustainable tourism; Local wisdom; Samosir

Introduction

Tourism in Samosir Regency has been growing since 2016, and it has become one of the Lake Toba areas designated as a super-priority tourism destination and a national strategic issue. Tourism development in Samosir Regency also serves as a substantial regional strengthening effort to achieve national development goals, supporting Asta Cita II (Hajar and Syafrizal, 2025; Renfors, 2021). As part of the national government's vision, it is necessary to emphasize the importance of creating a progressive, sustainable, and democratic society, all rooted in the supremacy of the rule of law. Thus, addressing not only the issue of increasing tourist visits but also complex environmental, socio-cultural, and economic issues is crucial (Bock *et al*., 2021; Downs, Cruz and Remengesau 2022; Hajar, Ramlan and Saputra 2024; Subair, Prianto and Amri, 2025). Samosir Regency, situated in the center of Lake Toba and designated as a national strategic area, offers significant advantages due to its stunning natural landscapes, rich Toba Batak cultural heritage, and a variety of nature-based and cultural tourism attractions. However, without careful planning based on local wisdom, this enormous potential can be diminished and even lead to spatial conflicts, environmental degradation, and the marginalization of local communities.

According to (Draçi and Demi 2023; Galluccio, Beccherle and Petrucci 2025; Siakwah, Musavengane and Leonard 2020; Thi *et al.*, 2024; Halunko *et al.* 2024; Junus, Harun and Napir, 2024). Unsustainable tourism often leads to environmental degradation and conflicts with local cultural values, resulting in a decline in visitor interest. This is relevant to the conditions in Samosir, where increasing tourist flows do not always align with improvements in the quality of life of local communities or the preservation of cultural and natural resources. The tourism policy implemented in Samosir Regency refers to the concept of regional development planning specifically for tourism areas, as outlined in Indonesia's Asta Cita II, which focuses on realizing a productive, independent, and competitive economy. Because this study utilizes cultural values and local wisdom as tourist attractions, the region can build a resilient community-based economy that is not dependent solely on resource exploitation. Moreover, it fosters an Indonesian society characterized by cultural identity, emphasizing the prioritization of local wisdom in regional planning as a tangible means of preserving and revitalizing the Toba Batak culture.

Based on Galluccio, Beccherle and Petrucci (2025) and Reid (2017), local wisdom-based tourism development planning is not only a technical or administrative effort but also an effort to harmonize the past (cultural heritage), the present (the needs of local communities), and a future that is ecologically and economically sustainable, including in Samosir Regency (Sumbayak, Waani and Tungka, 2021; Hajar, Priadi and Saputra, 2022; Hajar and Saputra, 2024). When local wisdom is placed as a foundation in planning, tourism becomes not only a source of income but also a means of preserving identity and building social cohesion (Sazali, Mailin and Harahap, 2022; Tuthaes, Toda and Lake, 2024). Local wisdom is a form of knowledge and practice that develops in society from generation to generation and becomes part of collective culture in the Samosir (Octavianna *et al.* 2020; Sibarani, Kimura and Simanjuntak, 2025) many local wisdoms have great potential in supporting sustainable tourism, including a) Dalihan Na Tolu, the Toba Batak kinship system that regulates social ethics; b) customary-based

environmental conservation systems, such as the prohibition of clearing land in forbidden forests or spring areas; c) cultural traditions, such as tortor, gondang, mangalahat horbo, and traditional ceremonies; d) cultural products, such as ulos weaving, gorga carvings, and typical culinary delights; e) traditional Batak houses such as the Bolon and Sopo houses. When these values are integrated into regional planning, a tourism development system will be formed that is not only attractive to tourists but also strengthens the identity and economy of local communities. Thus, planning for the development of tourism areas in Samosir Regency not only addresses local needs but also becomes part of the national effort in achieving Asta Cita and SDGs.

In accordance with this explanation, the concept of tourism development planning oriented towards local wisdom is not only relevant to the national development agenda (Asta Cita) but also supports the achievement of global development goals (SDGs). With the synergy between Asta Cita and SDGs, Samosir tourism development can become a national and even global asset for integrating local values into destination governance that is socially just, environmentally conscious, and economically sustainable. Tourism development is not only an instrument of economic growth, but also a vehicle for environmental preservation, strengthening local identity, and establishing harmonious social relations.

According to Hajar *et al*. (2021), through the Tourism Area Life Cycle (TALC), it explains that tourist destinations experiencing rapid growth without sustainable planning will enter a phase of stagnation, characterized by environmental damage, social conflict, and a decline in the quality of the tourism experience, as has occurred in the Lake Toba area, including Samosir Regency. Therefore, regional development planning requires an approach that considers the interrelationships between space, resources, and people. Tourism development planning necessitates an approach that takes into account the relationship between space, resources, and people (Hajar, Ramlan and Yuliani, 2024; Persada, 2018; Shijin, Jia and Lanyue, 2020). In tourism development planning, it is emphasized that the success of regional development is determined not only by physical capital, but also by the ability of local communities to manage and utilize existing potential (Annamalah *et al.*, 2023; Zhuang *et al.*, 2024). Therefore, active community involvement is key to ensuring sustainable development.

The tourism sector in Samosir Regency continues to focus on development based on core strengths, which are the driving force behind the region, as demonstrated by its regional potential. Therefore, there are tourist attractions that serve as resources for Samosir Regency, representing superior potential, as well as socio-cultural sustainability, which holds a crucial position because the local wisdom of the Toba Batak people is an intangible heritage that serves as a key differentiator compared to other destinations in Indonesia. Local wisdom is defined by several authors as a system of knowledge and values that regulates human interaction with the environment and each other (Rahman, 2024; Ramlan, Hajar and Saputra, 2023; Syafrizal, 2021). In Samosir, local wisdom is epitomized by the principle of Dalihan Na Tolu, which underscores kinship relations within the Toba Batak community, alongside the management of customary land that promotes ecological balance and cultural rituals tied to nature conservation (Mahrinasari, Bangsawan, and Sabri 2024; Octavianna *et al.*, 2020). Tourism success should be evaluated not merely by tourist numbers or investment value, but by its capacity to uphold ecological sustainability,

preserve cultural heritage, and enhance the well-being of local communities (Nugroho *et al.*, 2021; Sitompul, Alesyanti and Ridwan, 2020).

Studies state that the theory of sustainable tourism development planning emphasizes that local wisdom is not a complementary element, but rather the main foundation in planning the development of tourist areas (Amin *et al.*, 2025; Phillips and Roberts, 2013; Siakwah, Musavengane and Leonard, 2020). Also, tourism development planning is a systematic, directed, and participatory process for managing the potential of regional space to achieve certain goals (Annamalah *et al.*, 2023; Fu *et al.*, 2017), in this case sustainable tourism, which includes: a) inventory of regional potential and characteristics, including natural, social, and cultural resources; b) formulation of the vision and objectives of regional development; c) spatial planning and zoning of the region in accordance with its designation and environmental sensitivity; d) development of tourism infrastructure and accessibility; e) empowerment of local communities in the planning and implementation of tourism activities; f) periodic evaluation of the impact of tourism area development. Therefore, the concept of regional development planning in tourism areas in Samosir Regency cannot be separated from the characteristics and values that exist in the local community, including belief systems, lifestyles, customs, and social relations. Therefore, this study seeks to examine and formulate a planning model that combines a participatory approach, strengthening local wisdom, and the principles of sustainability, so that Samosir Regency can become an example of good practices in sustainable tourism development in Indonesia. The results of this study are also expected to show that 1) local wisdom is a central mediator that bridges the influence of regional development planning and tourism areas on sustainable development; 2) regional development planning has a direct and indirect influence on tourism sustainability; 3) tourism areas play a more indirect role (through local wisdom) than directly on tourism sustainability.

Methodology

This study employs a mixed methods approach, integrating both quantitative and qualitative methodologies to comprehensively examine the challenges of regional development planning for local wisdom-based tourism in Samosir Regency. This integration strategy is known as an explanatory sequential design, in which quantitative results are further explained through qualitative data (Creswell, 2014). Integration between quantitative and qualitative data is carried out at the analysis and interpretation stage of the results (Hatipoglu, Alvarez and Ertuna, 2016). Quantitative data provides information about the relationships between variables and the strength of their influence, while qualitative data provides the context and meaning of those relationships (Fonseca *et al.*, 2023; Rico and González, 2015).

A qualitative approach is used to explore in depth the values of local wisdom, as well as strategies for realizing sustainable tourism (Nurhaeni *et al.*, 2024; Strauss, 2016). This approach uses the Participatory Rural Appraisal (PRA) technique, which emphasizes the active participation of local communities in the process of identifying problems, mapping potential, and formulating solutions (Mustanir and Lubis, 2017), because it provides strategic advantages in understanding complex social phenomena while empirically testing the relationship between variables in regional development planning

for tourism areas based on local wisdom in Samosir Regency. The PRA approach was chosen because it aligns with the principles of sustainability and social justice, and can reveal local dynamics beyond the reach of a purely statistical approach. Meanwhile, a quantitative approach was used in this study to test the influence of variables formulated in the conceptual framework, such as regional development planning, tourism areas, local wisdom values, and sustainable tourism.

Data were collected through a Likert-scale questionnaire distributed to 100 respondents. The characteristics grouped in these respondents are seen from the categories of gender, age < 25 years, and > 54 years, job category, and income. Data analysis was carried out using Partial Least Squares Structural Equation Modeling (PLS-SEM) with the assistance of the Smart PLS 4.0 application. PLS was chosen because of its ability to handle complex structural models with a large number of latent indicators and data that do not necessarily have a normal distribution (Kulkarni, Joseph and Patil, 2024; Rahman *et al.*, 2020) and in determining the sample, purposive sampling was used, because not all populations were made respondents. SEM-PLS analysis suggests that a sample size of 100 to 200 is optimal for achieving model stability at a specified level of significance.

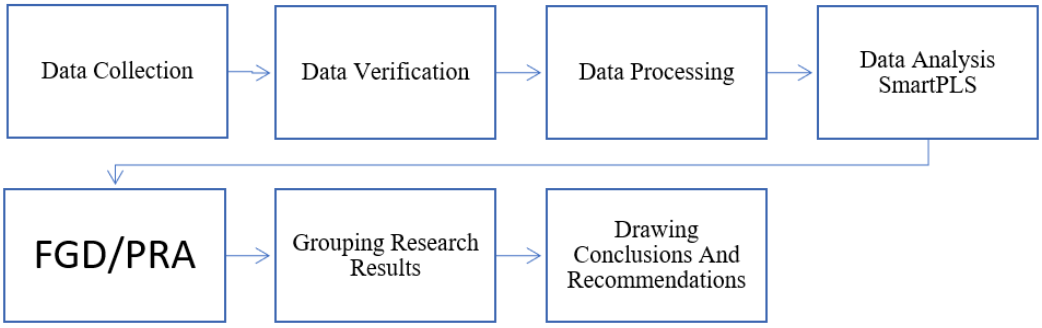

Figure 1. Methodological Flow of Research in Sustainable Tourism Development Planning

Figure 1 above explains the flow or stages in conducting this research, as follows:

1. Data Collection

The first stage in this process is data collection from various sources. This data can include the results of field surveys, interviews (see Appendix-1), direct observations, Focus Group Discussions (FGDs) and Participatory Rural Appraisal (PRA), as well as data from regional planning documents, tourism statistics, academic publications, or historical data from government agencies. PRA is a set of participatory methods used to gather information, analyze, and plan programs with the community, using tools participatory mapping which aims to draw maps of villages, resources, or facilities. The goal of this stage is to gather all the information needed to understand the potential, opportunities, and challenges in planning the development of tourism areas based on local wisdom.

2. Data Verification

After the data is collected, the next stage is data verification, which checks the validity and reliability of the data. Is the data relevant to the research objectives? Furthermore, it checks for duplicate, incomplete, or inaccurate data. This verification is crucial to ensure that the data used in the analysis truly represents the actual situation.

3. Data Processing

After verification, the data is then processed to prepare it for analysis. Processing can include data cleaning, coding qualitative data (interview results), and transforming quantitative data for analysis using statistical tools. The purpose of this stage is to prepare data in a form that can be interpreted systematically, both descriptively and inferentially.

4. Data Analysis

SmartPLS (Partial Least Squares - Structural Equation Modeling) is a statistical analysis tool used to test relationships between latent variables, quantitatively assess theoretical models, and present path diagrams and indicators of direct or indirect influence between factors. Using SmartPLS, a measurement model (outer model) is generated, including loading indicators, internal reliability, convergent validity, and collinearity. Subsequently, discriminant validity and a structural model (inner model) are tested, along with bootstrap settings. Following the quantitative analysis, this stage involves a participatory qualitative approach through focus group discussions with various stakeholders, such as community leaders, tourism managers, youth, and village government. The goal is to gain contextual and cultural understanding that cannot be captured through numbers alone, and to validate the results of the quantitative analysis locally.

5. Participatory Rural Appraisal (PRA) through Focus Group Discussions (FGDs)

Following the quantitative analysis, this stage involves a participatory qualitative approach through focus group discussions with various stakeholders, such as community leaders, tourism managers, youth, and village government officials. The goal is to gain contextual and cultural understanding that cannot be captured through numbers alone, and to validate the results of the quantitative analysis locally.

6. Grouping Research Results

Following the FGDs/PRAs, data obtained from various methods will be grouped based on main themes, respondent categories, and geographic regions if the research covers more than one area. This grouping helps to develop a more focused analysis and develop holistic, data-driven recommendations.

7. Conclusions and Recommendations

The final stage is a synthesis of all research findings on local wisdom-based regional development planning in tourism areas to support sustainable tourism in Samosir Regency.

Table 1: Operational Variables

No.	*Variable*	*Question*	*Skala Likert*
1.	Regional Development Planning (PPW)	1. The local government has a long-term plan for tourism development in Samosir. 2. Regional development policies take environmental sustainability into account. 3. The community is involved in the tourism development planning process.	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree

		4. Tourism infrastructure development aligns with the needs of the local community.	
2.	Tourist Area (KW)	1. The tourist area in Samosir has unique cultural attractions. 2. Tourism facilities (transportation, accommodation) are adequate to support tourists. 3. The environment of the tourist area is well-maintained. 4. Accessibility to tourist destinations is easy. 5. The carrying capacity of the tourist area takes ecological aspects into account. 6. Management of the tourist area involves the local community.	
3.	Local Wisdom (KL)	1. Toba Batak traditional values serve as guidelines for maintaining environmental sustainability in tourist areas. 2. Local cultural practices (e.g., traditional rituals and customary rules) are respected in tourism management. 3. The community supports tourism that does not conflict with local wisdom. 4. Customary rules play an important role in regulating tourist behavior.	
4.	Sustainable Tourism (PB)	1. Tourism provides economic benefits to local communities. 2. Tourism supports the preservation of local culture. 3. Tourism helps preserve the environment 4. Tourism improves the quality of life of communities surrounding destinations. 5. Sustainable tourism can be passed on to future generations.	

Source: Researcher Processing, 2025

Results

Samosir Regency, as part of the Lake Toba KSPN, has regional strengthening in the tourism sector through natural and cultural wealth that strongly supports the development of sustainable tourism (Indonesia, 2016; Ratman, 2016). Regional potential, such as natural and cultural wealth, is a unique feature of Samosir Regency

and also serves as a strengthening of local identity, especially the preservation of the Toba Batak. This suggests that tourism in Samosir Regency has great potential to be developed, especially with local content (Abdussamad, 2021; Harirah, Azwar and Isril, 2021). Local wisdom develops from the ability of local communities to adapt to the environment around the tourist area, passed down from generation to generation/inheritance, which is dynamic or is the result of a learning process through experience or by absorbing and assimilating ideas from various sources, and integrating them into the native culture. The natural beauty, strong Toba Batak culture, and living traditions make Samosir not only a tourist attraction but also a living space for the local community.

The progress of tourism in Samosir Regency is also shown by the increasing number of tourists visiting tourist destinations in Samosir Regency, as shown in the image below:

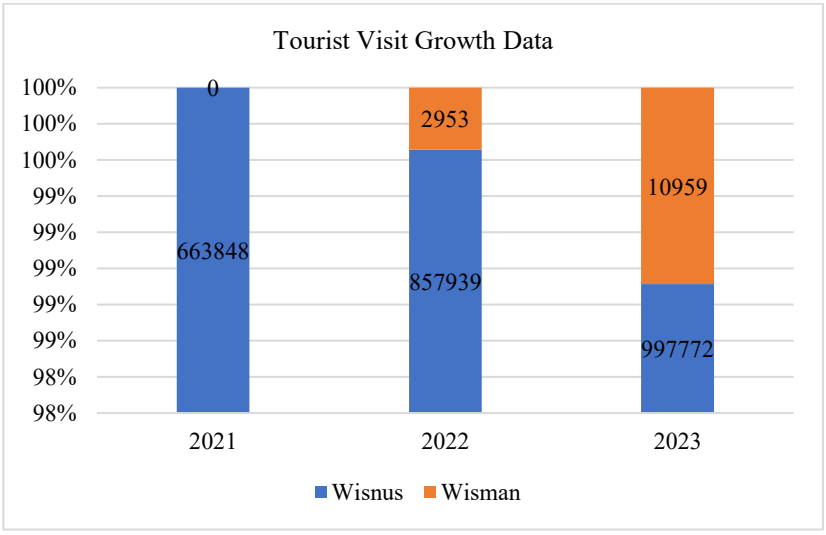

Figure 2. Data on the Growth of Tourist Visits in Samosir Regency

The increase in tourist visits has supported sustainable tourism in Samosir Regency, but in practice, it has not been maximized in the regional development planning process in tourism areas that are oriented towards local wisdom in Samosir Regency (Figure 2). Planning for local wisdom-based tourism development in the Samosir tourism area to support sustainable tourism must not only be seen from the development of tourism infrastructure, but also must pay attention to the revitalization of environmental conservation and the socio-cultural sustainability of the local community. The tourism sector in Samosir Regency is a leading source of regional income, thus creating significant economic opportunities for the communities surrounding the Samosir Regency's tourist areas (Hajar, Ramlan and Saputra, 2022; Samosir, 2023). The diversity of culture, customs, and natural beauty of Samosir Regency makes this region known as a leading tourist destination in North Sumatra Province. The tourism advantages of Samosir Regency support the creation of innovation and creativity within the community, creating cultural attractions and unique potential derived from natural resources and handicrafts. This explanation is also supported by the results of a survey conducted with 100 respondents with diverse demographic compositions.

Table 2: Outer Loading Values

Value	*Regional Development Planning*	*Tourist Area*	*Local Wisdom*	*Sustainable Tourism Development*
KAW.1	0.764			
KAW.2	0.800			
KAW.3	0.769			
KAW.4	0.800			
PPW.1		0.940		
PPW.2		0.947		
PPW.3		0.873		
PPW.4		0.843		
PPW.5		0.718		
PPW.6		0.785		
KL.1			0.871	
KL.2			0.823	
KL.3			0.711	
KL.4			0.766	
PB.1				0.803
PB.2				0.793
PB.3				0.855
PB.4				0.820
PB.5				0.814

Source: SMART PLS Quantitative Data Processing, 2025

Based on the outer loadings in table 1, all indicators have values above the minimum threshold of 0.70, indicating good convergent validity. The Regional Development Planning indicators (PPW.1–PPW.6) show a very strong contribution to their constructs, especially PPW.1 and PPW.2, with values above 0.94, indicating that certain aspects of regional development planning are very dominant in shaping respondents' perceptions. The indicators of local wisdom (KL.1–KL.4), sustainable tourism (PB.1–PB.5), and tourist areas (KAW.1–KAW.4) also show high indicator reliability, with values ranging from 0.711 to 0.855. This indicates that each question item is able to represent the construct being measured consistently and accurately. These findings strengthen the validity of the measurement model in this study and provide a strong basis for continuing the analysis on the structural model.

Table 3: R square

Variable	*R Square*	*R Square Adjusted*
Local Wisdom	0.860	0.857
Sustainable Tourism	0.803	0.796

Source: SMART PLS Quantitative Data Processing, 2025

Table 3 explains the R Square value, indicating how much of the variability of endogenous constructs can be explained by exogenous constructs in the model. In this result, the R Square value for the local wisdom variable is 0.860, which means 86% of the variability in sustainable tourism can be explained by independent variables in the model, while the remaining 14% is explained by other factors outside the model. Similarly, the sustainable tourism variable has an R Square value of 0.803, indicating that 80.3% of the variation in integrated tourism can be explained by the exogenous constructs that influence it. These values are included in the strong category, so it can be concluded that the structural model has high predictive power and is relevant in explaining the relationship between variables in the context of this study.

Table 4: Construct reliability and validity

Variable	*Cronbach's Alpha*	*rho_A*	*Composite Reliability*	*Average Variance Extracted (AVE)*
Tourist Area	0.924	0.934	0.942	0.731
Local Wisdom	0.804	0.816	0.872	0.632
Sustainable Tourism	0.876	0.877	0.909	0.668
Regional Planning Development	0.791	0.794	0.864	0.613

Source: SMART PLS Quantitative Data Processing, 2025

Table 4 presents the results of the reliability and construct validity tests, indicating that the four variables in the model possess good measurement quality. All variables exhibit Cronbach's Alpha and Composite Reliability values exceeding 0.70, demonstrating strong internal consistency of the instrument. The highest value is seen in the Tourism Area variable with a Cronbach's Alpha of 0.924 and a Composite Reliability of 0.942, indicating very high reliability. In addition, the Average Variance Extracted (AVE) values also all exceed the minimum limit of 0.50, indicating that each construct has adequate convergent validity, as more than 50% of the indicator variance can be explained by the construct. Thus, the four constructs tourism area, local wisdom, sustainable tourism, and regional development planning have met the requirements for use in further analysis in the research model.

Table 5: Path Coefficient

Type	*Original Sample (O)*	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T Statistics (|O/STDEV|)*	*P Values*
Tourist Area -> Local Wisdom	0.658	0.658	0.067	9.794	0.000
Tourist Area -> Tourism Sustainable	-0.047	-0.047	0.133	0.356	0.722
Local Wisdom -> Sustainable Tourism	0.571	0.571	0.163	3.504	0.000
Regional Development Planning -> Local Wisdom	0.316	0.318	0.073	4.339	0.000

Type	*Original Sample (O)*	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T Statistics (|O/STDEV|)*	*P Values*
Regional Development Planning -> Sustainable Tourism	0.407	0.406	0.102	4.009	0.000

Source: SMART PLS Quantitative Data Processing, 2025

Based on table 5, the path analysis results indicate a causal relationship between the variables in the model. First, the tourism area has a significant positive effect on local wisdom with a coefficient of 0.658 and a p-value of 0.000 (<0.05). This indicates that the higher the development of the tourism area, the greater its influence on the dynamics of local wisdom, likely due to the process of preserving local values that creates friction with external interests. However, the direct relationship between the tourism area and sustainable tourism is not significant (coefficient -0.047; p = 0.722), indicating that the tourism area has no direct influence on sustainable tourism development.

Furthermore, local wisdom has a significant positive effect on sustainable tourism (coefficient 0.571; p = 0.000), indicating that the development of local values actually encourages the formation of sustainable tourism, possibly as an effort to develop a superior and competitive tourism area. Regional development planning also has a significant effect on local wisdom (coefficient 0.316; p = 0.000), indicating that good tourism planning can direct or tourism development planning also has a significant effect on sustainable tourism (coefficient 0.407; p = 0.000), indicating that effective planning contributes directly to sustainable tourism development. Thus, the tourism area variable seems to play a more indirect role through local wisdom, while regional development planning provides direct and indirect contributions to sustainable tourism..

Table 6: Indirect effect

Effect Type	*Original Sample (O)*	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T Statistics (|O/STDEV|)*	*P Values*
Tourist Area -> Local Wisdom -> Sustainable Tourism	0.376	0.376	0.114	3.299	0.001
Regional Development Planning -> Local Wisdom-> Sustainable Tourism	0.181	0.182	0.069	2.627	0.009

Source: SEM PLS Quantitative Data Processing, 2025

Table 6 explains that first, the path of tourist area → local wisdom → sustainable tourism shows a coefficient of 0.376, with a T-statistic value of 3.299 and a p-value of 0.001. This value is statistically significant (p < 0.05), indicating that local wisdom is an effective mediator in bridging the influence of regional development planning on sustainable

tourism. This means that regional development planning has a positive and significant effect on sustainable tourism (β = 0.407; p = 0.000). Effective regional development planning significantly enhances support for sustainable tourism in Samosir. This relationship underscores the importance of preserving local wisdom, which fosters dynamics that improve the efficacy of regional development strategies. Consequently, local wisdom catalyzes the integrated development of tourism areas, providing a viable solution for promoting sustainable tourism. Second, the regional development planning → local wisdom → sustainable tourism pathway also showed significant results, with a coefficient of 0.181, a t-statistic of 2.627, and a p-value of 0.009. This indicates that local wisdom also mediates the influence of regional development planning on sustainable tourism. This means that regional development planning efforts can foster the development of local wisdom, ultimately encouraging the realization of sustainable tourism.

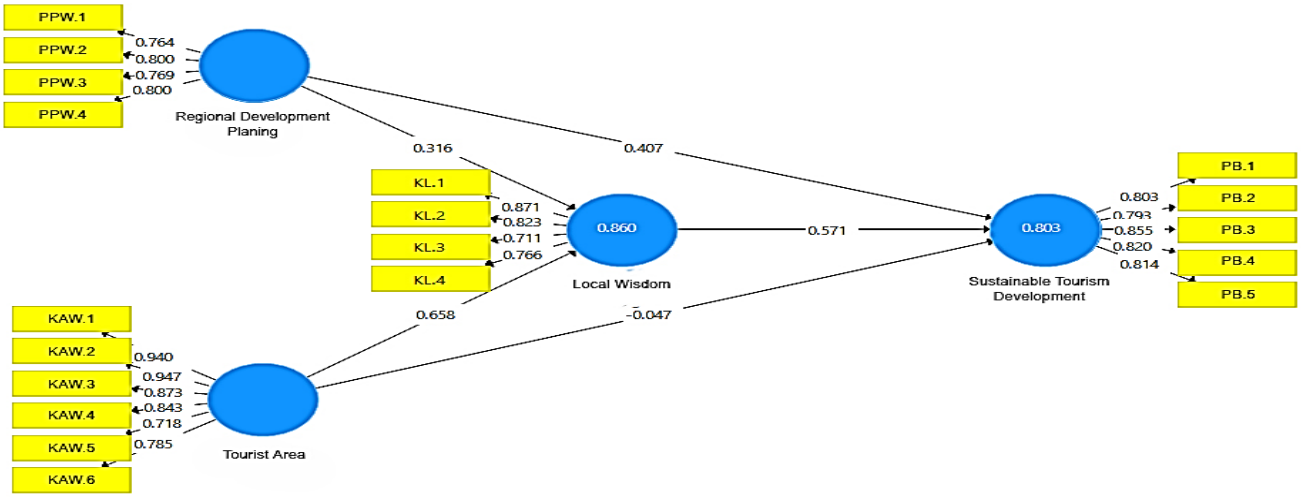

Figure 3. Path Coefficient Results [*Source*: Quantitative Data Processing using PLS SEM, 2025]

Based on figure 2, the results of the analysis using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method, obtained a picture of the relationship between constructs in the regional development planning model based on local wisdom for sustainable tourism. Each construct is supported by indicators that have loading values above 0.70, indicating that each indicator is valid in representing the construct. From the results of the structural modeling, it was found that regional development planning has a positive effect on local wisdom (β = 0.316) and also directly affects sustainable tourism (β = 0.407). This indicates that the better the regional development planning implemented, the more potential local wisdom can be identified and developed, and sustainable tourism can be realized more optimally in the tourist area of Samosir Regency. Meanwhile, local wisdom has a very strong influence on sustainable tourism (β = 0.658) and confirms that local values have a significant role in developing tourist areas and supporting sustainable tourism. However, the direct effect of local wisdom on sustainable tourism appears very small and negative (β = -0.047), suggesting that local values have not been fully integrated into regional development planning strategies, or that there is potential community resistance to regional development planning models deemed inappropriate to the local context.

Local wisdom itself demonstrates a strong influence on sustainable tourism (β = 0.571), indicating that the ability to develop tourism areas is key to implementing regional development planning strategies. The coefficients of determination (R^2) for the local wisdom and sustainable tourism constructs are 0.860 and 0.803, respectively, demonstrating the model's strong ability to explain the variability within each construct. Overall, these results demonstrate that regional and tourism area development planning strategies based on local wisdom must be strengthened, not only within the context of development but also in the formulation of comprehensive and integrated tourism policies.

Tourism development planning, oriented toward local wisdom value systems and practices, is a systematic process for designing spatial utilization within a specific area to support optimal, targeted, and sustainable tourism activities. This process encompasses regional potential analysis, spatial planning, infrastructure development, environmental conservation, and community empowerment within Samosir Regency. Furthermore, tourism areas are viewed not merely as economic objects, but as living spaces with social, cultural, and ecological values that need to be protected and developed wisely. Several villages that are leading tourism areas in developing local wisdom and are included in priority tourism development planning are Huta Siallagan, Tomok, and Lumban Suhisuhi. The lack of community involvement in formulating tourism policies in these areas poses a significant challenge for the government. Engaging local populations in decision-making and the development of tourism plans that reflect local values is essential for effective regional development. In accordance with the results of the PRA approach through FGD, the optimization of regional development planning for tourism areas based on local wisdom in Samosir Regency remains hindered by the minimal involvement of local communities in tourism policy planning and the weak enforcement of customary norms as an instrument for identifying local wisdom.

Furthermore, the involvement of key actors such as traditional leaders, tourism attraction managers, community groups, and traditional institutions has significant potential in establishing collaborative governance mechanisms. However, relationships between actors remain sectoral and uncoordinated systematically. Therefore, strengthening local institutional capacity through adaptive and inclusive policies is crucial in regional development planning, encouraging cross-sectoral integration among stakeholders. This research emphasizes the importance of regional development planning strategies through the revitalization of local values as a foundation for realizing sustainable tourism, where sustainability principles can be managed collaboratively, democratically, and equitably. Several stages of regional development planning based on local wisdom in tourism areas in Samosir Regency include:

1. Identification of local potential and values, involving participatory mapping of nature- and culture-based tourism potential, such as a) historical sites, traditional houses, and local religious rituals; b) natural landscapes with spiritual or ecological value; c) local economic products derived from traditions, such as weaving, carvings, or traditional culinary arts. Communities are involved to identify the significance of a location (historical sites, customary forests, sacred sites) and forms of cultural expression (music, dance, crafts, culinary arts) that are worthy of development as tourist attractions.

2. Active involvement of local communities, through participatory approaches such as Participatory Rural Appraisal (PRA), involves communities from the initial stages: a) exploring community aspirations and concerns; b) determining development priorities; and c) developing internal regulations or customary-based governance.
3. Integration into regional spatial planning, where spatial planning takes into account customary zones, conservation zones, and tourism zones. Not all regions can be classified as tourist attractions; some must be preserved as sacred or quiet zones (buffer zones). Therefore, zoning of tourist areas includes cultural and natural conservation zones, active tourism zones, buffer and residential zones, and spiritual or sacred zones with restricted access.
4. Locally-based infrastructure planning, where supporting infrastructure such as homestays, roads, places of worship, and souvenir centers are built using a local architectural approach, using natural materials, and adapting to the local climate and culture.
5. Development of local human resources and institutions, namely training communities to a) become tour guides based on folklore and local history; b) manage tourism businesses (cooperatives, BUMDes, traditional communities); c) compile interpretive tourism narratives that respect local culture.

Based on the research results obtained, the implementation of regional development planning that is oriented towards the development of local wisdom in Samosir Regency can be mapped, namely:

Table 7: Development of Local Wisdom in Priority Areas in Samosir Regency

No.	*Village Name*	*Description of Local Wisdom Development*
1.	Tomok	1. The Tomb of King Sidabutar and the Sigale-gale performance. 2. Community involvement as tour guides and souvenir sellers. 3. Immediate commercialization of culture without deepening understanding of indigenous cultural values. 4. Strengthening cultural narratives and cultural interpretation training for the younger generation.
2.	Huta Siallagan	1. The trial stone site and traditional houses are the main attractions. 2. The area's layout still prioritizes the preservation of traditional architecture. 3. Potential is developing educational tourism about the Batak customary legal system.
3.	Lumban Suhi Suhi	1. Center for traditional ulos crafts. 2. Still using manual weaving techniques passed down from generation to generation. 3. Need to strengthen branding and diversify products and tourism-based marketing channels.

Source: FGD Data Processing, 2025

Based on table 6, regional development planning that integrates local wisdom serves not only as a physical development strategy but also as a socio-cultural approach that positions the community as the owners and guardians of local identity. In Samosir, this approach has proven effective in strengthening tourist attractions, preserving Toba Batak culture, and creating a just and sustainable tourism system. Through participatory mapping practices, local value-based zoning, the involvement of indigenous communities, and multi-stakeholder collaboration, the Samosir tourism area can emerge as a model for vibrant and dignified culture-based tourism development.

Based on these explanations, the challenges in planning sustainable tourism development are:

1. *Cultural Commodification*
   Local wisdom, which should be preserved as a living value, is often over-commercialized in the form of mass performances or souvenirs. This results in the loss of original cultural meaning, shifting values, and potential conflict between indigenous groups due to symbolic exploitation.
2. *Lack of Local Human Resource (HR) Capacity*
   Many communities have not received adequate training in tourism services, business management, and cultural interpretation. This results in dependence on outside parties or investors, which can marginalize local communities from the processes and benefits of tourism.
3. *Lack of Customary-Based Governance Regulations*
   Not all tourist villages have village regulations or binding mechanisms regarding zoning of sacred areas or mechanisms for sharing tourism benefits. This impact has the potential to lead to spatial conflicts, violations of customary values, and overexploitation of land.
4. *Inequality in Infrastructure Between Regions*
   Many tourist villages in Samosir still lack access to roads, clean water, communication networks, and other basic facilities. The impact is limiting tourist mobility and the distribution of visits outside the main areas, such as Tomok, Huta Siallagan, and Lumban Suhi Suhi.
5. *Pressure on the Natural and Social Environment*
   Infrastructure development and increased tourism can increase waste, lake pollution, and the degradation of cultural sites. These impacts undermine environmental carrying capacity and threaten the cultural heritage that is the main attraction.

Meanwhile, the opportunities derived from this research are also expected to support sustainable tourism, as follows:

1. *Authentic Batak Toba Cultural Wealth*
   Samosir boasts a complete cultural system, such as Dalihan Na Tolu, traditional houses, royal tombs, gondang music, ulos, and traditional rituals. This presents an opportunity to become a unique experiential tourism attraction that cannot be replicated elsewhere.
2. *Local Community Awareness and Spirit*
   Many indigenous communities and local youth are actively managing tourist villages, establishing cooperatives, or arts communities. This offers the

potential to become key drivers of sustainable tourism and agents of cultural preservation.

3. *Government Support and KSPN Status*
   Samosir is included in the Lake Toba National Strategic Tourism Area (KSPN), which receives support from the central government's infrastructure and policies. This offers opportunities for access to development funds, national and international promotion, and multi-sectoral collaboration.
4. *Potential for Ecotourism and Cultural Education Development*
   Natural landscapes, lakes, and local culture offer the potential for the development of themed tourism, such as spiritual tourism, ulos weaving workshops, traditional forest trekking, or Batu Peridangan. The opportunity lies in the verification of environmentally friendly and culturally immersive tourism products.
5. *Technological Readiness and Digital Platforms*
   Digitalization offers opportunities for tourism promotion, homestay bookings, and cultural education via online platforms. This allows local communities to reach a wider market without relying on large agencies.

Sustainable tourism development planning in Samosir faces systemic challenges, particularly in terms of local capacity, regulations, and threats to cultural preservation. However, the opportunities are enormous if development is carried out with a participatory and contextual approach that involves the community as the main actor, integrates local values in spatial planning, tourist attractions, and services, and utilizes natural and cultural potential in a balanced manner, so that tourism not only provides economic benefits but also strengthens identity and environmental sustainability. With the right strategy, Samosir Island can become a leading example of culture-based tourism development and local wisdom in Indonesia.

Discussion

The regional development planning process for local wisdom-based tourism areas in Samosir Regency still faces various structural and cultural challenges. One key finding is the gap between formal local government policies and the socio-cultural practices of local communities in managing tourism resources (Hariati, 2024; Sibarani, Kimura and Simanjuntak, 2025; Sitompul, Alesyanti and Ridwan, 2020), that the unique geography and culture of the Batak have made this area a leading destination that combines ecological and cultural values, however, sustainable tourism development planning in this area faces many serious challenges that must be faced, such as minimal community involvement in decision-making related to regional development planning in tourism areas based on local wisdom, pressure on local culture, and sustainable tourism that has not been effectively integrated. Several studies state that the local wisdom-based tourism development planning is an approach that not only supports the sustainability of tourism but also strengthens the identity and independence of local communities (Choi, Ashurova and Lee, 2021; dos Anjos and Kennell, 2019; Hajar, 2025).

This approach is holistic (Dredge and Jamal, 2015; Hu *et al.*, 2024; Séraphin *et al.*, 2018a) because it combines economic, social, cultural, and ecological dimensions. With active community involvement and respect for local values, areas like Samosir can grow

as unique, sustainable, and dignified tourist destinations. As shown in previous findings (Steinke *et al.*, 2024; Wiyatiningsih *et al.*, 2023), strengthening local values and traditional spatial planning, if managed in a participatory manner, can increase tourist visits while strengthening social cohesion in the community. Studies also emphasized that in creating a map of cultural potential and establishing tourism zones, the results showed an increase in the welfare of residents involved in tourism activities based on weaving and traditional culinary arts (Hajar *et al.*, 2024; Tuthaes, Toda and Lake, 2024). Local wisdom is the knowledge, values, practices, and norms that arise from the experience and adaptation of communities to their environment over centuries. Therefore, from this explanation, it is very important to plan tourism development that is oriented towards local wisdom in tourist areas that not only strengthens local identity, community ownership, and environmental sustainability but also places the community not as an object but as the main subject of tourism development.

Meanwhile, sustainable tourism development planning does not only involve administrative planning and sectoral policies but also reflects how various actors, including the government, local communities, business actors, and tourists, can interact collaboratively and fairly in developing tourist destinations (Hajar *et al.*, 2019; Sentanu *et al.*, 2023; Yan, Gao and Zhang, 2017). The success of sustainable tourism is always based on the principle of "from the community, by the community, and for the community" (Farsari, 2023; Galluccio, Beccherle and Petrucci, 2025; Lundén and Varnajot, 2024). Therefore, the government, academics, and tourism industry players need to make local wisdom not merely an attractive ornament, but a core value system in tourism planning and management in Samosir.

Good tourism development planning must be able to unite various interests through transparent, adaptive, and accountable participatory mechanisms (Guo and Sun, 2016; Séraphin *et al.*, 2018b; Turvey, 2019). Therefore, sustainable tourism development is closely linked to the development of local wisdom as a means of strengthening regional resources, including in Samosir Regency. According to (Irjayanti and Lord, 2024; Schwann, 2018; Steiner, 2019), local wisdom is a social and cultural asset rich in sustainable values. It serves as a philosophical foundation for resource management and social relations, serving as a strong pillar in tourism governance. Local wisdom must be integrated into tourism policy design and practices to create harmony between development and conservation. However, in reality, many tourism policies are still top-down and focused on economic interests, creating a power imbalance between large players (investors) and local communities.

However, in reality, many tourism policies are still top-down and focused on economic interests, creating a power imbalance between large actors (investors) and local communities. This study also has several limitations, including its cross-sectional design, which limits causal inference, a relatively small sample size (n = 100), which limits the generalizability of the findings, the potential for social desirability bias, a geographic coverage that only includes priority villages, and the possibility of seasonal bias in tourism data. For future research, longitudinal evaluations to assess long-term impacts, experimental trials (e.g., RCT-based community training) to assess the effectiveness of interventions, and cost-benefit analyses of destination zoning strategies are recommended. Expanding the scope to non-priority villages and using mixed

quantitative-ethnographic methods would also strengthen the transferability and depth of the findings.

Conclusion

Sustainable tourism development based on local wisdom on Samosir Island is a strategic approach that addresses the need to balance regional economic growth with cultural and environmental preservation. As a region located at the heart of the Lake Toba National Tourism Strategic Area (KSPN), Samosir possesses extraordinary potential, both in terms of natural beauty and the richness of the Toba Batak culture, which is deeply rooted in the local community.

Local wisdom in Samosir is reflected in various socio-cultural practices and values, such as the Dalihan Na Tolu system, traditional house architecture, traditional performing arts (tortor, gondang), and ulos weaving. These values are not only part of the community's identity but also important assets in developing authentic and value-added tourist destinations. Utilizing local wisdom as the basis for regional planning can enhance Samosir's appeal as a distinct tourist destination. This approach involves structured stages: identifying local potential, mapping cultural and ecological features, engaging the community, developing zoning strategies, and ensuring equitable and sustainable resource management. This approach positions local communities as key actors in development, not merely objects of tourism exploitation.

However, implementing this concept faces a number of challenges that cannot be ignored. These include the risk of cultural commodification, the low capacity of local human resources to manage tourism professionally, the lack of customary-based regulations, and environmental pressures from uncontrolled development activities. If not addressed wisely, these conditions could damage cultural integrity and reduce the environmental carrying capacity of Samosir Island. Nevertheless, the opportunities available are significant and promising. Public awareness of the importance of cultural preservation is increasing, several tourist villages are beginning to grow independently, and government support through the KSPN program is providing space for investment and sustainable infrastructure development. Furthermore, the development of digital technology provides opportunities for local communities to market cultural products and tourism services more widely without relying on external parties.

Developing tourism based on local wisdom on Samosir Island is not only possible but also highly relevant in the context of sustainable development. With synergy between the local government, indigenous communities, academics, and business actors, Samosir Island can become a national model for developing tourism rooted in culture, protecting the environment, and improving local welfare. These efforts need to be supported by inclusive policies, values-based tourism education, and a collaborative governance system based on the principles of justice and conservation.

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Appendix-1: Interview Questions

1. How do you view the current development of tourism on Samosir Island?
2. In your opinion, what does "sustainable tourism" mean in the context of Samosir Island?
3. What role does the local wisdom of the Batak people play in supporting tourism development here?
4. What are the main obstacles faced in planning sustainable tourism on Samosir Island?
5. How does the influx of tourists impact the natural environment (lakes, forests, and culture) in Samosir?
6. Is there a conflict between the economic needs of tourism and the preservation of local customs and traditions?
7. What is the community's view on the development of tourism infrastructure in this area?
8. In your opinion, what local wisdom potential can be leveraged to attract sustainable tourism?
9. What new job and business opportunities will the development of the tourism sector create for local communities?
10. To what extent can local governments, indigenous communities, and businesses collaborate to develop sustainable tourism?
11. Are local youth involved in promoting Batak culture through tourism?
12. What strategies are most effective for maintaining a balance between economic, social, cultural, and environmental aspects in tourism development in Samosir?
13. What are your expectations for the role of the government, community, and investors in realizing sustainable tourism based on local wisdom?
14. If there were one major change you desired for tourism in Samosir, what would you consider most urgent?

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*
Conceived and designed the research or analysis	Yes	No
Collected the data	Yes	No
Contributed to data analysis & interpretation	Yes	Yes
Wrote the article/paper	Yes	Yes
Critical revision of the article/paper	No	Yes
Editing of the article/paper	No	Yes
Supervision	No	Yes
Project Administration	Yes	No
Funding Acquisition	No	No
Overall Contribution Proportion (%)	50	50

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Research involving human bodies or organs or tissues (Helsinki Declaration)
The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

Research involving animals (ARRIVE Checklist)
The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. The contexts of animals were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work.

Research on Indigenous Peoples and/or Traditional Knowledge
The author(s) solemnly declare(s) that this research has not involved Indigenous Peoples as participants or respondents. The contexts of Indigenous Peoples or Indigenous Knowledge were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

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The author(s) solemnly declare(s) that this research has not involved the plants for experiment and field studies. Some contexts of plants are also indirectly covered through literature review. Thus, during this research the author(s) obeyed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

Research Involving Local Community Participants (Non-Indigenous) or Children
The author(s) solemnly declare(s) that this research has directly involved local community participants or respondents belonging to non-Indigenous peoples. This study did not involve any child in any form directly. The contexts of different humans, people, populations, men/women/children and ethnic people were only indirectly covered through literature review. Therefore, a prior informed consent (PIC) of the respondents or Self-Declaration in this regard is appended.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

Competing Interests/Conflict of Interest
Author(s) has/have no competing financial, professional, or personal interests from other parties or in publishing this manuscript. There is no conflict of interest with the publisher or the editorial team or the reviewers.

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To see original copy of these declarations signed by Corresponding/First Author (on behalf of other co-authors too), please download associated zip folder [Declarations] from the published Abstract page accessible through and linked with the DOI: https://doi.org/10.33002/nr2581.6853.080244.

INFORMATION AND CONSENT FORM FROM RESPONDENTS
(Non-Indigenous Respondents)
This form was translated into local language for the respondents

Title of the Research: Planning for Sustainable Tourism Development based on Local Wisdom in Samosir Island, Indonesia: Challenges and Opportunities

Principal Researcher:	Mohammad Yusri Department of Agribusiness, Universitas Islam Sumatera Utara, Medan, Indonesia. Jl. Karya Wisata, Medan Johor, Medan City, Indonesia
Research Supervisor:	Siti Hajar Department of Public Administration, Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia

A) INFORMATION TO PARTICIPANTS

1. Objectives of the research
The objectives of this study were to develop a planning strategy for sustainable tourism on Samosir Island, drawing upon local wisdom and practices.

2. Participation in research
The researcher will ask you several pertinent questions. This interview will be recorded in written form and should last about 50-60 minutes. The location and timing of the interview will be determined by you, depending on your availability and convenience.

3. Risks and disadvantages
There is no particular risk involved in this project. You may, however, refuse to answer any question at any time or even terminate the interview.

4. Advantanges and benefits
You will receive intangible benefits even if you refuse to answer some questions or decide to terminate the interview. You will also contribute integrated into regional development planning for tourism areas, thereby fostering sustainable tourism and promoting adaptive, inclusive policies

5. Confidentiality
Personal information you give us will be kept confidential. No information identifying you in any way will be published. In addition, each participant in the research will be assigned a code and only the researcher will know your identity.

6. Right of withdrawal
Your participation in this project is entirely voluntary and you can at any time withdraw from the research on simple verbal notice and without having to justify your decision, without consequence to you. If you decide to opt out of the research, please contact the researcher at the telephone number or email listed below. At your

request, all information concerning you can also be destroyed. However, after the outbreak of the publishing process, it is impossible to destroy the analyses and results on the data collected.

B) CONSENT

Declaration of the participant

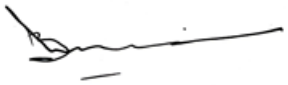
- ⇨ I understand that I can take some time to think before agreeing or not to participate in the research.
- ⇨ I can ask the research team questions and ask for satisfactory answers.
- ⇨ I understand that by participating in this research project, I do not relinquish any of my rights, including my right to terminate the interview at any time.
- ⇨ I have read this information and consent form and agree to participate in the research project.
- ⇨ I agree that the interviews be recorded in written form by the researcher: Yes ( ) No ( )

Signature of the participant : _____ Date : _____

Surname : _____ First name : _____

Researcher engagement

I explained to the participant the conditions for participation in the research project. I answered to the best of my knowledge the questions asked and I made sure of the participant's understanding. I, along with the research team, agree to abide by what was agreed to in this information and consent form.

Signature of the researcher :  Date : 11-09-2024

Surname: Yusri First name: Mohammad

- ⇨ Should you have any questions regarding this study, or to withdraw from the research, please contact Dr. Siti Hajar by e-mail sitihajar@umsu.ac.id
- ⇨ If you have any concerns about your rights or about the responsibilities of researchers concerning your participation in this project, you can contact the Yusri, Department of Agribusiness, Universitas Islam Sumatera Utara, Jl. Karya Wisata, Medan Johor, Medan City, Indonesia by email mohdyusri@fp.uisu.ac.id